Earth Science Data Systems Software Reuse Working Group
2007 Year-end Report

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2007 Accomplishments

Activities during 2007 included recommendations to NASA HQ to encourage and enable software reuse, completion of an architecture study and initial development of a prototype reuse enablement system for internal NASA use, continued development and maintenance of a web-based portal, development of a peer-recognition award process, development of technology transfer guidelines, and development of reuse readiness levels. These efforts are related to one another, and their success has been due in part to our interactions with other working groups through joint meetings. Throughout the year, we have held monthly full working group telecons and weekly support group telecons.

Recommendations to and Response from Headquarters: We recommended that NASA develop standard language for use in future procurement and grant notices that will encourage more software reuse, establish a web-based information portal for the sharing and dissemination of information about software reuse practices for the Earth science community, and establish a Reuse Enablement System (RES) to facilitate cataloging and distribution of reusable assets for the Earth science community.

HQ has responded positively to our suggestions and is developing language to implement them, e.g., in the ROSES (Earth science) announcements. HQ encourages the continued development of the Software Reuse web site (http://www.esdswg.org/softwarereuse). HQ is in the process of reviewing the results of our RES Trade Study and RES Architecture Study, which at the time of writing was being prepared for presentation to HQ.

Architecture Study: At HQ's request, we conducted a trade study of existing software catalogs and repositories in 2006. We concluded that none of the existing sites fulfill the role of a software repository for the Earth science community, and none of the systems provide the capabilities needed to function as a reuse enablement system. Therefore, this year, we conducted an architecture study to determine an expeditious and cost-effective solution for the recommended Reuse Enablement System (RES). We studied three software packages (XOOPS, Savane, and GForge) and one existing system (the GCMD) in detail. Our results showed that the open source content management system XOOPS met more requirements and failed fewer requirements than the other three systems examined, giving it the lowest estimated development

time at approximately 8 staff-months. Also, members of the WG were most satisfied with how XOOPS implemented our requirements.

RES Prototype: Based on the results of our architecture study, we developed a build plan for creating a prototype RES for internal NASA use, using XOOPS as the foundation of the system. The gap analysis performed in the architecture study indicated what modifications were needed in order to meet all of our requirements. These modifications were then ordered and grouped into three builds and one release. We have completed the modifications for Build 3, and plan to complete development of the prototype by spring 2008, providing the first release of a complete RES. This prototype will be presented to HQ as a recommendation for building an actual RES.

Portal Web Site: We designed, developed, and now maintain a web site (http://www.esdswg.org/softwarereuse) for providing news and information on reusable assets, links to various catalogs (e.g., GCMD, Ames and GSFC Open Source), links to funding opportunities, and dates and contact information for upcoming events relevant to software reuse. Statistics have shown increases in the number of unique, new, and repeat visitors, as well as an increase in the number of visits over the past year. This year, October 2007 was our most popular month with 640 visits and over 2,500 page views from 483 unique visitors, almost 94% of them being new.

The WG continued to review nominated selected references for articles to be cited on the portal web site as external resources relevant to software reuse. The WG followed the procedure developed last year of having at least three independent reviews of each nominated article, with the consensus opinion deciding if the article is added to the portal web site. Reviews completed in 2007 resulted in recommendations for two articles and one book to be referenced on the portal web site. These have been added to the site, and the WG continues to review relevant articles as they are nominated.

Other Resources: We also developed and now maintain a collaboration web site and a WG mailing list. We are also developing a mailing list for announcements related to the RES.
Collaboration Web Site: http://www.sciencedatasystems.org/reuse/default.aspx
Mailing List: http://majordomo.gsfc.nasa.gov/cgi-bin/majordomo/info/software_reuse (web site is Goddard-only access)
RES List: http://softwarereuse.net/lists/

Peer-Recognition Award: As part of our work to encourage reuse, we developed a draft process for a Peer-Recognition Software Reuse Award for consideration by HQ. The award is intended to recognize those people whose efforts and projects contribute to the practice of software reuse in the Earth science community. The award would consist of a certificate of recognition, an article of recognition featured on the WG portal web site (http://www.esdswg.org/softwarereuse), announcement of award receipt at the annual ESDS WG meeting, and acknowledgement of award receipt in the Software Reuse WG annual report. We are currently revising our process according to feedback received and researching the standard process for instituting new awards at NASA.

Technology Transfer Guidelines: We reopened communication with the Innovative Partnerships Program (IPP) Office in order to better understand the technology transfer process at NASA, so that we can publicize this information to the Earth science community and help them in their reuse efforts. We interviewed a number of scientists and developers who have gone through the process about their experiences with it, interviewed members of the IPP Office about the process, and attended two training courses offered by the IPP Office on the technology transfer process. We used the information we collected to create a guideline and Frequently Asked Questions (FAQ) document about the NASA Goddard technology transfer process. Members of the IPP Office have reviewed them for us, and upon their approval, the documents were posted on our portal web site for public distribution.

Reuse Readiness Levels (RRLs): Leading into the 6th Joint ESDSWG Meeting (Oct. 2007), we researched and discussed various topics in software reuse as viewed from the perspective of an individual developer while factoring in what a reuser of the software asset would be interested in knowing. We created a set of levels numbered 1 through 9 for each of nine different topics considered important for measuring reuse readiness. We also began creating a single set of levels that would summarize all of the topic levels. We presented our work on RRLs at the 6th Joint ESDSWG Meeting and discussed the topic within our own WG to develop a draft set of summary levels, which were then presented to the other WGs for comments and feedback. The RRLs were viewed with much interest, and we received a lot of feedback from the other WGs. We are currently considering how to address their comments. This is the beginning of work that will continue into next year, and will provide individuals with more guidelines on reuse. The RRLs will be presented to HQ as a recommendation for measuring the reuse maturity of reusable software assets.

Publications and Presentations:

- Samadi, S.; Gerard, R.; Hunter, M.; Marshall, J.J.; Schweiss, R.J.; Wolfe, R.E.; Masuoka, E.J., "Reusing Software to Build Data Processing Systems: NPP Science Data Segment Case Study", *Aerospace Conference, 2007 IEEE*, pp.1-12, 3-10 March 2007. Presented at the 2007 IEEE Aerospace Conference (March 2007, Big Sky, MT)
- Gerard, R.; Downs, R.R.; Marshall, J.J.; Wolfe, R.E., "The Software Reuse Working Group: A Case Study in Fostering Reuse", *Information Reuse and Integration, 2007. IRI 2007. IEEE International Conference on*, pp.24-29, 13-15 Aug. 2007. Presented at the 2007 Information Reuse and Integration Conference (August 2007, Las Vegas, NV)
- Software Reuse Working Group, "Reuse Readiness Levels (RRLs) – A Work in Progress", presentation at the 6th ESDS WG Meeting (October 2007, Philadelphia, PA)
- Gerard, N. "A Prototype Software Reuse Enablement System (RES)", demonstration at the 6th ESDS WG Meeting (October 2007, Philadelphia, PA)
- Marshall, J.J., Berrick, S.W., Bertolli, A., Burrows, H., Delnore, V.E., Downs, R.R., Enloe, Y., Falke, S., Folk, M., Gerard, N., Gerard, R., Hunter, M., Jasmin, T., McComas, D., Samadi, S., Sherman, M., Swick, R., Tilmes, C., Wolfe, R.E., "Reuse Readiness Levels (RRLs): Proposed Topic Area Levels" poster presented at the 6th ESDS WG Meeting (October 2007, Philadelphia, PA)
- Bertolli, A., Marshall, J.J., Downs, R.R., Falke, S., Gerard, R., Husar, R., Jasmin, T., Lynnes, C., Wolfe, R.E.. "Lessons in Software Reuse for Earth Science Projects", *GSA Abstracts with*

Programs, Vol. 39, No. 6, p. 64. Presented at the 2007 Geological Society of America Meeting (October 2007, Denver, CO)

- Marshall, J.J., Berrick, S.W., Bertolli, A., Burrows, H., Delnore, V.E., Downs, R.R., Enloe, Y., Falke, S., Folk, M., Gerard, N., Gerard, R., Hunter, M., Jasmin, T., McComas, D., Samadi, S., Sherman, M., Swick, R., Tilmes, C., Wolfe, R.E., "A Community-Developed Measurement of the Reusability of Software Through Reuse Readiness Levels", *Eos Trans. AGU, 88*(52), Fall Meet. Suppl., Abstract IN31A-0074, in press. Presented at the 2007 AGU Fall Meeting (December 2007, San Francisco, CA)

2008 Planned Activities

Tasks for Enablement and Policy:

- *Reuse Enablement System:* Complete and submit architecture study, develop implementation plan, continue developing and testing prototype, deploy the prototype for internal NASA use, develop and vet RES policies (internal and external).
- *Reuse Portal:* Provide more content and keep up-to-date, promote portal to community.
- *Provide Incentives for Reuse:* Follow NASA's award process to get official recognition and acceptance of our proposed peer-recognition software reuse award, work on recommendation/justification for HQ to develop a funding opportunity to make assets/components reusable within the Earth science community.
- *Metrics/Measurement:* Continue to generate/analyze statistics for portal web site, assess efforts required to package assets for reuse, quantify the benefits of open source release of assets, and examine technology transfer process for small vs. large software components.
- *Promote Reuse:* Continue publications in journals and presentations at conferences, prototype a process for facilitating reuse through mentoring, continue developing reuse readiness levels.
- *Policy:* Continue working with IPP Office to facilitate software release process, work to understand and change the process (lowering barriers for certain types of software).

The goal of all activities for 2008 is to present HQ with recommendations for the use of the products developed.

WG Partnerships: Focus on areas of cooperation and collaboration with other WGs, use the Technology Infusion WG capability vision/roadmap as a framework, engage Interoperable Information (Web) Services, help with metadata definition, identify reusable assets for categories of web services components, HDF product content standards, and identify reusable assets for implementing a possible standard.

Outreach and Education Strategy: We plan to identify outreach and education activities for each audience segment, explore communication opportunities for each activity and audience, prioritize activities to optimize capabilities and interests of team, and develop and identify resources to foster reuse awareness and understanding. Further, we plan to submit articles to Earth science journals, magazines, and bulletins, post Reuse WG announcements on list servers and newsletters, establish community collaboration forums for sharing reuse experiences, and utilize the portal to disseminate outreach and education resources on reuse.

Challenges: We recognize the need to reach out to other Earth Science domains, such as the modeling community (ESMF), the National Forum for Geoscience Information Technology (FGIT), NOAA, EPA, ESIP, etc.

Table 1 – 2007 Contributing Working Group Members

Member Name	Affiliation	NASA-Funded Project	NASA-Funded Project PI
Stephen Berrick	NASA GSFC		
Angelo Bertolli	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	
Howard Burrows	Autonomous Undersea Systems Institute (AUSI) / National Science Digital Library (NSDL)	ESIP Federation	
Nancy Casey	SSAI / NASA GSFC	REASoN – Ocean Color Time-Series Project	Watson Gregg
Victor E. Delnore	NASA LRC	REASoN – Synergistic Data Support of Atmospheric Chemistry Field Campaigns / Chemical Digital Atlas	Victor Delnore
Robert R. Downs	Columbia University Center for International Earth Science Information Network (CIESIN)	Socioeconomic Data and Applications Center (SEDAC)	Robert S. Chen
Yonsook Enloe	SGT Inc. / NASA GSFC	ACCESS – The Development and Delpoyment of a CEOP Satellite Data Server	Kenneth McDonald
Stefan Falke	Washington University in St. Louis	REASoN – Services for Helping the Air-quality community use ESE Data (SHAirED)	Stefan Falke and Rudolf Husar
Albert Fleig	PITA / NASA GSFC		
Neil Gerard	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	
Ryan Gerard	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	
Mary Hunter	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	
Tommy Jasmin	University of Wisconsin Space Science and Engineering Center	REASoN – Satellite Observations in Science Education (SOSE)	Steven Ackerman
James J. Marshall	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	
David McComas	NASA GSFC		

Shahin Samadi	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	
Mark Sherman	SGT Inc. / NASA GSFC	ACCESS – High Spatial and Temporal Resolution Continental Water Mass Anomaly Fields from GRACE: Improving Accessibility for Hydrological Research and Applications	David Rowlands
Ross Swick	National Snow and Ice Data Center	Distributed Active Archive Center	
Curt Tilmes	NASA GSFC	Atmospheric Composition Processing System (ACPS)	Curt Tilmes
Robert E. Wolfe	NASA GSFC	ACCESS – Improving Access to Land and Atmosphere Science Products from Earth Observing Satellites: Helping NACP Investigators Better Utilize MODIS Data Products	Jeffrey Morisette

Table 2 – Additional 2007 Working Group Members

Member Name	Affiliation	NASA-Funded Project	NASA-Funded Project PI
Nadine Alameh	MobiLaps / NASA GSFC	Geosciences Interoperability Office	
Bradford Castalia	University of Arizona	High Resolution Imaging Science Experiment (HiRISE)	Alfred McEwen
Mike Folk	National Center for Supercomputing Applications (NCSA)	HDF Support for EOSDIS	
Emily Greene	Raytheon / NASA GSFC	Microwave Limb Sounder	
Gary Jackson	University of Maryland		
Michael Leyton	Rutgers University		
Stephen Olding	Everware-CBDI / NASA JPL	ESDS Technology Infusion Working Group	
Maciek Smuga-Otto	University of Wisconsin Space Science and Engineering Center		
Bill Teng	SSAI / NASA GSFC	REASoN – Integrating NASA ESE Data into Global Agricultural Decision Support Systems	Steven Kempler
Frederick Watson	California State University Monterey Bay	REASoN – Systems Integration & Visualization of Yellowstone (SIVY)	Frederick Watson
Jonathan Wilmot	NASA GSFC		